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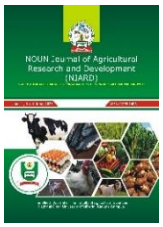

Original Article

Evaluation of post-harvest handling practices of horticultural crops among rural farmers in Kogi State, Nigeria.

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Abstract

The study evaluated post-harvest handling practices of selected horticultural crops (fruits and vegetables) among rural farmers in Kogi State, Nigeria. A sample of 205 respondents was selected using stratified and simple random sampling techniques. Data were collected using a structured questionnaire and analyzed with descriptive and inferential statistics. Results showed that the majority (76.5%) of respondents were aged 41–60 years, 57.5% were male, and 67.5% were married. Most farmers (62.5%) had no formal education, 57% cultivated about three hectares of land, and 58% had over 26 years of farming experience. Annual income for most respondents (61%) ranged between ₦100,000 and ₦150,000. Six traditional post-harvest practices were predominant: washing and cleaning with hot water (Mean = 3.14), hand sorting and grading (M = 2.99), head-loading and truck transport (M = 2.83), packaging in woven baskets (M = 2.76), and hand-picking for harvesting (M = 2.72). The use of modern post-harvest practices was generally low. Factor analysis revealed three major categories of challenges: socio-economic (low income, poor access to credit, lack of extension services, and limited education), environmental (high temperature and low humidity), and infrastructural (inadequate storage, packaging, and transportation facilities). The Kruskal-Walli's test (R1 = 100.4, R2 = 100.9, R3 = 99.9) showed no significant differences across agricultural zones in farmers' awareness of modern practices. It was recommended that gender disparities be reduced to ensure equal access to farm inputs, while extension services should intensify training on improved handling, processing, storage, and packaging. Furthermore, public and private investment in Agro-based industries is necessary to support processing and packaging of horticultural produce in Kogi State.

Keywords: *Post-harvest losses; Rural farmers; Horticultural crops; Storage practices; Kogi State, Nigeria.*

Introduction

The horticulture sector in Nigeria plays a vital role in food security, nutrition, and economic growth. However, post-harvest losses remain a critical challenge, with an estimated 30–40% of produce lost after harvest (FAO, 2022). Such losses undermine farmers' incomes and reduce the availability of fresh produce despite rising demand. Recent studies have emphasized the need for improved post-harvest management to reduce waste and enhance rural livelihoods (Adebayo & Chukwu, 2023; Ogunlela & Mukhtar, 2022).

Food losses occur at all stages of post-harvest handling—storage, packaging, transportation, processing, and marketing (Sebeko, 2015). For perishable crops such as fruits and vegetables, high water content accelerates physiological processes like respiration, making them highly susceptible to deterioration under tropical conditions of high temperature and humidity (Ibeawuchi et al., 2015; Atanda et al., 2011). In

Nigeria, poor storage, inadequate packaging, and weak transportation infrastructure further exacerbate these losses, which often reach 20–30% of total production (Dhatt & Mahajan, 2007; Salami et al., 2010).

Recent research confirms that these challenges persist, with qualitative losses—such as reductions in nutritional value, consumer acceptability, and caloric quality—proving even more difficult to address than quantitative losses (Kader, 2005; Adole et al., 2024). Studies conducted across sub-Saharan Africa also show that traditional packaging materials, such as woven baskets, sacks, and wooden crates, often cause mechanical injury, heat buildup, and spoilage during transit (Kitinoja & Alhassan, 2012; Hurst, 2010; Arah, 2015). While alternative low-cost, recyclable materials like corrugated fibreboard and plastic crates have been tested with positive results (Saran et al., 2012), adoption in Nigeria remains low.

In Nigeria, rural farmers face persistent constraints in post-harvest management, including limited access to modern storage facilities, reliance on traditional handling practices, and weak market linkages (Olayemi et al., 2022; Adole et al., 2024). Despite the availability of improved technologies, adoption remains minimal due to low awareness, inadequate extension services, and poor access to credit.

Although several studies have examined post-harvest losses in Nigeria, few have specifically analyzed the handling practices of rural horticultural farmers in Kogi State. Understanding the methods used, the constraints faced, and the factors influencing adoption of modern practices is critical for designing interventions to reduce losses and improve produce quality.

This study therefore evaluates post-harvest handling practices of horticultural crops among rural farmers in Kogi State, Nigeria, with the aim of identifying effective strategies to minimize losses and enhance farmers' livelihoods.

Statement of the Problem

The magnitude of postharvest loss in Nigeria is very high, ranging from 5 to 26% for different crops. Many developing countries of Africa such as Nigeria, though richly blessed in agricultural resources have acute fruits and vegetable shortages thus cannot meet up with the food and nutritional requirements of its citizenry due to improper postharvest management technologies of these fruits and vegetables (Carrasco and Urrestarazu, 2010).

Despite the huge advantages in using moder-n postharvest technologies in processing horticultural crops which boost agricultural production and reduce wastage, farmers in rural areas have little or no access to modern post-harvest handling practice which are considered of great benefit to them. The above scenario indicates that even when farmers have access to these modern post-harvest handling practice, they may lack the technical knowhow on its operation. However, baseline information on utilization of modern post-harvest handling practice is scarce. It is against this backdrop that this study was carried out.

The broad objective of the study was to evaluate post-harvest handling practices of selected horticultural crops among rural farmers in Kogi state, Nigeria

The specific objectives were to:

i. describe the socio-economic characteristics of horticultural farmers in the study area;
ii. identify post-harvest handling practices of horticultural crop practiced by the farmers in the study area.
iii. ascertain the challenges faced by horticultural farmers on post-harvest handling practices of their produce.

Statement of Hypotheses

Ho_1**:** There is no significant relationship between socio-economic characteristics of respondents and the use of modern postharvest management technologies.

Methodology

The study was conducted in Kogi State, Nigeria. The state was created on 27 August 1991, with an estimated population of 3,314,043 people and a land area of 35,123 km² (NPC, 2006). The major ethnic groups are Igala, Ebira, and Okun. Administratively, the state is divided into four agricultural zones: Zone A (Aiyetoro-Gbedde), Zone B (Anyigba), Zone C (Koton-Karfe), and Zone D (Alloma) (KGADP, 2011). Kogi State

comprises 21 Local Government Areas (LGAs), including Lokoja, Adavi, Ankpa, Idah, Ajaokuta, Bassa, Dekina, Kogi, Yagba East, Ofu, Igalamela-Odolu, Yagba West, Ibaji, Okene, Ijomu, Olamaboro, Okehi, Omala, Ogori-Magongo, Mopa-Muro, and Koton-Karfe. The state is a major producer of horticultural crops such as orange, tomato, lettuce, pepper, and mango (KGADP, 2011).

Figure 1: Presents a map of Kogi State showing the selected agricultural zones and study locations. The map was carefully labeled to enhance clarity and ease of interpretation.

Sampling Procedure and Sample Size
A sample size of 205 respondents was determined using stratified and simple random sampling techniques. Two LGAs were randomly selected from each of the three agricultural zones (Alloma, Anyigba, and Koton-Karfe). Specifically, Olamaboro and Ofu were selected from Alloma Zone; Omalla and Ankpa from Anyigba Zone; and Lokoja and Kogi from Koton-Karfe Zone. In each selected LGA, two extension cells were further chosen at random. A sampling frame was developed for each LGA, and a proportional allocation of 10% was applied across the board, resulting in a total of 205 respondents.

Table 1: Sample Size Selection Plan

Zone	Local Government Area	Sampling Frame	10% (0.1)	Sample Size
Alloma Zone	Olamaboro	230	23	23
	Ofu	320	32	32
Anyigba Zone	Ankpa	480	48	48
	Omalla	390	39	39
Koton-Karfe Zone	Lokoja	240	24	24
	Kogi	390	39	39
Total	6 LGAs	2,046	–	205

Source: Field survey (2024)

Data Collection
Primary data were collected using a well-structured questionnaire complemented by interview techniques. The questionnaire was pre-tested with 20 farmers outside the study area to ensure clarity and relevance. Content validity was established through expert review by agricultural extension specialists, while reliability was assessed using Cronbach's alpha, which yielded a coefficient of 0.82, indicating good internal consistency.

Data Analysis

Descriptive statistics (frequency distributions, percentages, means, and standard deviations) were used to summarize socio-economic characteristics and post-harvest handling practices. Factor analysis was employed to identify and group major challenges affecting post-harvest handling, while the Kruskal-Walli's test was used to examine differences across agricultural zones. Ordered logit regression was applied to test the hypothesis regarding the relationship between socio-economic characteristics and the level of adoption of modern post-harvest technologies. These methods were chosen because they align with the study's objectives: description (descriptive statistics), categorization of challenges (factor analysis), group comparisons (Kruskal-Wallis), and hypothesis testing (ordered logit regression).

Results and Discussion

Socioeconomic Characteristics of Respondents

Evidence from Table 2 revealed that 19.5% of respondents were between 21–40 years, 76.5% were within 41–60 years, while 4.0% were above 60 years. This suggests that the majority were still within their active and productive years. This agrees with Adewumi et al. (2007), who stated that farming is largely undertaken by individuals between 21–60 years.

Results also showed that 57.5% of the respondents were male and 42.5% female. This implies that men played the dominant role in farming, as farm work is often considered strenuous. Aidoo et al. (2014) similarly observed that male-headed households commit more man-hours to farming compared to women.

Household size was generally large, with a mean of 14 persons. This indicates greater availability of family labor, which supports faster harvesting and handling. The low level of education (62.5% with no formal education) suggests that many respondents relied on traditional methods, as limited literacy makes adoption of modern technologies more difficult. Obinne (1991) emphasized that education strongly influences adoption of innovations.

Farm size was relatively small, with a mean of 2.6 ha, indicating that most respondents were smallholders. Small-scale farming, while easier to manage, increases vulnerability to losses if post-harvest practices are inadequate. Most respondents (91.5%) were farmers by occupation, with an average of 27.2 years' experience, showing long familiarity with traditional practices. Annual farm income was low, with 66.5% earning ≤ ₦100,000, further restricting capacity to adopt improved technologies.

Table 2: Distribution of Respondents According to Socioeconomic Characteristics

Variables	Frequency	Percentage (%)	Mean
Sex			
Male	115	57.5	–
Female	85	42.5	–
Age (years)			49.1
21–40	39	19.5	
41–60	153	76.5	
Above 60	8	4.0	
Marital Status			
Single	3	1.5	–
Married	135	67.5	
Divorced	28	14.0	
Widowed	21	10.5	
Separated	13	6.5	
Level of Education			
Non-formal	125	62.5	–
Primary	44	22.0	
Secondary	26	13.0	

Variables	Frequency	Percentage (%)	Mean
Tertiary	5	2.5	
Household Size (No.)			14.0
1–5	7	3.5	
6–10	29	13.9	
11–15	74	37.0	
Above 15	69	34.5	
Occupation			
Farming	183	91.5	–
Trading	9	4.5	
Civil Servant	7	3.5	
Teaching	1	0.5	
Farm Size (ha)			2.6
<1	29	14.5	
1–2	62	28.5	
>3	114	57.0	
Farming Experience (yrs)			27.2
<5	1	0.5	
6–15	19	9.5	
16–25	64	32.0	
>25	116	58.0	
Annual Farm Income (₦)			₦98,310
≤100,000	133	66.5	
100,001–150,000	61	30.5	
150,001–200,000	5	2.5	
>200,000	6	0.5	
Association Membership			
Member	68	31.5	–
Non-member	137	68.5	

Source: Field survey (2024)

Traditional Post-Harvest Handling Practices

The traditional post-harvest methods practiced in the study area included hand-picking for harvesting (M = 2.72), hand sorting and grading (M = 2.99), washing with hot water (M = 3.14), woven baskets for packaging (M = 2.76), and head-loading for transportation (M = 2.83). These practices are cheap, accessible, and familiar, but they also increase susceptibility to damage, losses, and reduced quality.

This finding aligns with Soyebo et al. (2005), who reported that most smallholder farmers depend on traditional practices due to poverty and lack of technical know-how. It suggests that while farmers are aware of handling needs, they are constrained by resources and exposure to better technologies.

Modern Post-Harvest Handling Practices

Use of modern technologies was very limited. Farmers occasionally used motorcycles (M = 2.99) and motor cars (M = 2.07) for transportation, and chlorine solution in washing and packing operations (M = 1.25). Plastic crates, cold storage, and automated sorting or grading had negligible usage (M = 1.00).

The low use of modern technologies reflects inadequate awareness, limited extension services, and financial barriers. This agrees with Adebayo et al. (2023), who emphasized that weak extension systems hinder farmers from adopting improved post-harvest technologies in Nigeria.

Table 3: Distribution of Respondents According to Traditional Post-Harvest Handling Practices

Management Practice	Method	Minimum	Maximum	Mean	Std. Deviation
Harvesting	Use knife	1	1	1.00	0.000
	Hand picking	1	3	2.72	0.461
Packing house operation	Dumping	1	3	2.26	0.454
Sorting	Use of hand	1	3	2.99	0.158
Grading	Use of hand	1	3	2.99	0.141
Washing & cleaning	Cold water	1	2	1.16	0.368
	Hot water	1	3	3.14	0.213
Packaging	Sack	1	2	2.00	0.071
	Woven basket	1	3	2.76	0.652
	Bags	1	3	1.23	0.640
Storage	Sun-drying	1	3	2.60	0.695
	Shade	1	3	2.15	0.376
Transportation	Head load	1	3	2.83	0.390
	Truck	1	3	2.43	0.506
	Animal	1	1	1.00	0.000
Post-harvest treatment	Hot water	1	2	1.16	0.368

Source: Field survey (2024)

Table 4: Distribution of Respondents According to Modern Post-Harvest Handling Practices

Management Practice	Method	Minimum	Maximum	Mean	Std. Deviation
Harvesting	Harvester	1	1	1.00	0.000
Packing house operation	Chlorine use	1	2	1.25	0.432
Sorting	Automatic sorting	1	1	1.00	0.000
Grading	Automatic grading	1	1	1.00	0.000
Washing & cleaning	Chlorine solution	1	1	1.00	0.000
Packaging	Plastic crate	1	1	1.00	0.000
Storage	Refrigerator	1	1	1.00	0.000
Transportation	Motor car	1	3	2.07	0.282
	Motor cycle	1	3	2.99	0.141
	Train	1	1	1.00	0.000
Post-harvest treatment	Chemical use	1	2	1.11	0.314

Source: Field survey (2024)

Challenges in Post-Harvest Handling

Factor analysis (Table 5) grouped challenges into three categories: socio-economic, environmental, and infrastructural. Socio-economic challenges included low education, poor access to credit, high cost of transportation, and lack of extension services. Environmental challenges such as high temperature and low humidity were also significant, while infrastructural challenges included inadequate storage and poor packaging and transportation systems.

These results underline that post-harvest losses are not just technical but also socio-economic. Farmers' low income and limited access to credit hinder investment in improved methods, while weak infrastructure exacerbates losses during storage and transportation. Atanda et al. (2011) similarly found that poor storage and distribution systems drive high post-harvest

losses in perishable produce across sub-Saharan Africa.

Table 5: Factor Analysis of Challenges Faced by Farmers in Post-Harvest Handling

Variable	Factor 1 (Socio-economic)	Factor 2 (Environmental)	Factor 3 (Infrastructural)
Inadequate storage facilities (ISF)	0.007	-0.064	0.685*
Low skilled labour (LLSL)	0.362*	0.088	-0.027
Low income/capital (LI/C)	0.733*	0.007	0.003
Low awareness (LLA)	0.915*	0.036	-0.011
Poor credit access (PACF)	0.733*	0.077	0.175
Lack of extension services (LES)	0.363*	0.009	-0.022
Low education (LLE)	0.887*	-0.243	-0.095
Poor transport system (PTS)	0.082	-0.063	0.697*
Poor packaging facilities (PPF)	0.079	0.224	0.608*
High transport cost (HCT)	0.817*	-0.036	0.032
High labour cost (HCL)	0.909*	0.037	0.122
High temperature (HAT)	-0.013	-0.982	0.106
Strong wind (SW)	0.009	0.365	0.118
Low humidity (LH)	-0.223	0.841	0.016
High altitude (HA)	-0.006	0.002	0.051

Extraction method: Varimax with Kaiser Normalisation (≥0.30 shown)
Source: Field survey (2024)

Table 6: Ordered Logistic Regression Estimates Showing Relationship Between Socio-economic Characteristics of Farmers and Use of Modern Post-Harvest Handling Practices

Variable	**Estimate**	**Std. Error**	**Wald**	**Df**	**Sig.**
Threshold [Level_use = 1]	1.112	1.617	0.473	1	0.492
Threshold [Level_use = 2]	1.745	1.620	1.159	1	0.282
Age	0.074***	0.041	3.184	1	0.074
Education	-0.121	0.248	0.239	1	0.625
Annual income	3.325E-05*	9.714E-06	11.714	1	0.001
Farm size	-1.228*	0.369	11.051	1	0.001
Household size	-0.055	0.054	1.044	1	0.307
Farming experience	-0.056***	0.033	2.801	1	0.094
Awareness of MPHT	-0.485	0.401	1.464	1	0.226
Sex (0/1)	-0.167	0.411	0.166	1	0.684
Occupation (0/1)	2.045*	0.579	12.464	1	0.000
Marital status (0/1)	-0.307	0.412	0.554	1	0.457
Association membership (0/1)	-0.571	0.380	2.263	1	0.132

Model fitting $\chi^2 = 253.683$, $p < 0.01$
Source: Field survey (2024)

Test of Hypotheses

Results from the Ordered Lo``````````````````git Regression (Table 6) showed that socio-economic characteristics significantly influenced adoption of modern post-harvest technologies ($\chi^2 = 253.683$, $p < 0.01$).

- **Positive influences**: Age ($p < 0.10$), annual income ($p < 0.01$), and occupation ($p < 0.01$) increased adoption.
- **Negative influences**: Farm size ($p < 0.01$) and farming experience ($p < 0.10$) reduced likelihood of adoption, possibly because larger farms and more experienced farmers tend to be more risk-averse.

These findings agree with Ogunlela & Mukhtar (2022), who stressed that education and income strongly shape adoption of agricultural innovations.

Implications for Policy and Extension

The findings suggest that addressing post-harvest losses requires an integrated approach:

- **Extension services** must be strengthened to provide farmers with technical knowledge on affordable, locally adaptable practices.
- **Financial support** through credit facilities and subsidies would allow farmers to invest in improved storage and packaging.
- **Infrastructure development**, especially feeder roads and storage centers, is essential to reduce transport and storage losses.
- **Awareness campaigns** should emphasize the long-term economic benefits of modern post-harvest methods.

By tackling socio-economic, environmental, and infrastructural barriers, policy interventions can significantly reduce post-harvest losses and improve food security and incomes in Kogi State and beyond.

Conclusion and Recommendations

Conclusion

This study evaluated post-harvest handling practices of horticultural crops among rural farmers in Kogi State, Nigeria. The findings revealed that farmers predominantly relied on traditional methods due to limited education, low income, and inadequate access to credit and extension services. Three categories of constraints—socio-economic, environmental, and infrastructural—were identified as major contributors to post-harvest losses.

The study underscores that addressing post-harvest losses requires not only technical solutions but also socio-economic empowerment, improved infrastructure, and targeted extension support. Strengthening these areas will enhance farmers' capacity to adopt modern practices, reduce waste, and increase food availability and household incomes.

Recommendations

Based on the findings, the following targeted recommendations are made:

1. **Address gender disparities in access to resources**: Policymakers should ensure equal access to farm inputs and training for both male and female farmers through gender-sensitive extension programs. At least **40% of extension beneficiaries** should be women to close the participation gap.
2. **Strengthen farmer cooperatives for financial access**: Farmers should be mobilized into cooperative societies to improve bargaining power and access to credit. Government and NGOs should provide **low-interest loans and revolving credit schemes** to cooperatives, particularly targeting smallholders.

3. **Enhance agricultural extension education**: Agricultural extension services should prioritize functional literacy and technology-transfer training to raise awareness of modern post-harvest methods. A minimum of **two farmer field schools per Local Government Area annually** should be established in Kogi State.
4. **Capacity building through regular on-field training**: Extension agents should organize **seasonal training sessions** on harvesting, processing, storage, and packaging to reduce spoilage during transportation. Training should include demonstrations on low-cost technologies such as plastic crates, evaporative coolers, and improved packaging materials.
5. **Invest in infrastructure development**: Government should prioritize construction of **rural feeder roads, storage facilities, and market centers** to reduce transport delays and losses. Public–private partnerships (PPP) can be leveraged to establish **community-level cold storage facilities** for perishables.
6. **Promote climate-resilient practices**: Farmers should be trained to adopt affordable adaptive measures (e.g., shade nets, moisture-retaining storage) to mitigate environmental challenges like high temperature and low humidity.
7. **Future research**: Further studies should assess the cost–benefit of introducing affordable post-harvest technologies at the smallholder level, and evaluate the long-term impact of cooperative membership on reducing losses.

References

Adebayo, T., & Chukwu, E. (2023). Post-harvest losses in horticultural crops: A review. *Journal of Agricultural Science*, *15*(2), 1–10.

Adole, P., Peter, I., & Naswem, A. (2024). Impact of socio-economic characteristics on post-harvest management technologies of selected horticultural crops among farmers in Kogi State, Nigeria. *ADAN Journal of Agriculture*, *5*(1). Retrieved from https://adanjournal.org.ng/index.php/adanj/article/view/87

Ahmed, B. O., Idris, A. K. M., & Lawal, A. O. (2015). Food security and postharvest losses in fruit marketing in Lagos Metropolis, Nigeria. *Discourse Journal of Agricultural and Food Sciences*, *3*(3), 52–58.

Agi, A. I. (2015). *Agricultural extension policy: Contemporary cum topical issues.* Makurdi, Nigeria: Kaneys Printing Press.

Alam, M., & Goyal, G. K. (2007). Packaging and storage of tomato puree and paste. *Stewart Postharvest Review*, *3*, 1–8.

Alazar, A. (2007). *Horticultural marketing in Ethiopia* (MSc thesis). Haramaya University, Haramaya.

Ani, D. P. (2010). *Productive efficiency of Benue farmers using food legume as soil fertility restoration agent* (Unpublished thesis). University of Agriculture, Makurdi.

Atanda, S. A., Pessu, P. O., Agoda, S., Isong, I. U., & Ikotun, T. (2011). The concepts and problems of postharvest food losses in perishable crops. *African Journal of Food Science*, *5*(11), 603–613. https://academicjournals.org/journal/AJFS/article-full-text-pdf/30EFBA310005

Arah, I. K. (2015). An overview of postharvest challenges facing tomato production in Africa. In *Africa: Diversity and Development* (Proceedings of the 37th AFSAAP Conference). AFSAAP. Retrieved from http://afsaap.org.au/assets/Arah-Isaac-Kojo.-An-overview-of-postharvest-challenges.pdf

Carrasco, G., & Urrestarazu, M. (2010). Green chemistry in protected horticulture: the use

of peroxyacetic acid as a sustainable strategy. *International Journal of Molecular Sciences, 11*(5), 1999–2009. https://doi.org/10.3390/ijms11051999

El-Ramady, H. R., Domokos-Szabolcsy, É., Abdalla, N. A., Taha, H. S., & Fári, M. (2015). Post-harvest management of fruits and vegetables: Storage. In *Post Harvest Management of Fruits and Vegetables* (pp. 65–152). Springer. https://doi.org/10.1007/978-3-319-09132-7_2

FAO, IFAD, UNICEF, WFP, & WHO. (2022). *The State of Food Security and Nutrition in the World 2022*. Food and Agriculture Organization. https://doi.org/10.4060/cc0639en

Hailu, G. (2015). Extent, causes and reduction strategies of postharvest losses of fresh fruits and vegetables – A review. *Journal of Biology, Agriculture and Healthcare, 5*(5).

Kader, A. A. (2005). Increasing food availability by reducing postharvest losses of fresh produce. In F. Mencarelli & P. Tonutti (Eds.), *Proceedings of the 5th International Postharvest Symposium* (Acta Horticulturae, Vol. 682, pp. 2169–2176). ISHS. https://doi.org/10.17660/ActaHortic.2005.682.296

Ogunlela, A. O., & Mukhtar, A. A. (2022). Post-harvest management practices among smallholder farmers in Nigeria: A review. *Journal of Agricultural Extension, 16*(1), 1–10.

Olayemi, F. F., Adegbola, J. A., Bamishaiye, E. I., & Aawagu, E. F. (2012). Assessment of postharvest losses of some selected crops in eight local government areas of Rivers State, Nigeria. *Asian Journal of Rural Development, 2*(1), 13–23.

Olayemi, F. F., Adegbola, J. A., Bamishaiye, E. I., & Daura, A. M. (2010). Assessment of post-harvest challenges of small-scale farm holders of tomatoes, bell and hot pepper in some local government areas of Kano State, Nigeria. *Bayero Journal of Pure and Applied Sciences, 3*, 39–42.

Salami, P., Ahmadi, H., Keyhani, A., & Sarsaifee, M. (2010). Strawberry postharvest energy losses in Iran. *Researcher, 4*, 67–73.

National Population Commission (NPC). (2006). *Nigeria national census: Population distribution by sex, state, LGAs and senatorial districts* (Priority Table, Vol. 3). NPC.

Kogi State Agricultural Development Project (KGADP). (2011). Impact of Fadama Development Project II on rice farmers' profitability in Kogi State, Nigeria. *Journal of Agricultural Extension, 15*(1).